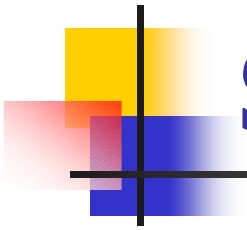
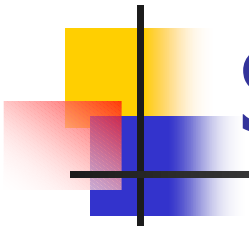


STAR DAQ School

- What is STAR DAQ?
- What is it made off?
- How does it work?
- How to make it work?
- What to do when it doesn’t work!



School comments…

- This is all still very rough…
- A "DAQ Cookbook and FAQ" will be on the web soon

  http://daq.star.bnl.gov/~daq/daqfaq.pdf
- "DAQ Manual" is on the web which explains things in more detail

  http://daq.star.bnl.gov/~daq/daqmanual.pdf
- This "DAQ School" will be on the web too

  http://daq.star.bnl.gov/~daq/daqschool.pdf

What is STAR DAQ?

(Depends how you look at it…)

- Massively parallel multiprocessing system based on custom-made computers hierarchically organized and interconnected with backplane buses and a fast network fabric *(that's what we claim in our publications…)*
- Hierarchical Event Builder with Level 3 Trigger preprocessing *(that's what it's meant to be…)*
- Bunch of VME crates tied together with an even bigger bunch of miscellaneous unlabeled cables with lots of confusing blinking lights labeled with TLAs for which even their author doesn't know what they stand for… *(that's what it looks like…)*

Theory of operation

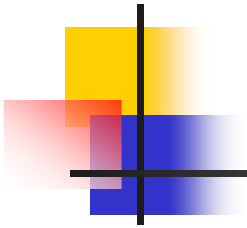
(TPC, SVT, SSD, FTPC i.e. detectors with Receiver Boards)

- **An event comes down from the fiber at the same time setting the corresponding BUSY**
- **It is stored in DAQ buffers (typically 12 for the TPC/SVT/SSD/FTPC)**
  - **If there are more free buffers the BUSY is reset enabling another event**
  - **If not the BUSY stays until a buffer is freed**
- **For TPC/SVT/SSD/FTPC the event is preprocessed in the Mezzanine CPUs and 2-dimensional clusters are found**
- **The event is "announced" to the Global Broker (GB) CPU via the Sector Broker (SB) CPUs**
- **At the "same" time the Trigger announces the event (via the Trigger-DAQ CPU (TDI)) to DAQ's Global Broker – this Trigger information tells the Global Broker which Detectors are present in this event**
- **Global Broker starts managing the Sector Level 3 scheme by telling (currently only TPC's) Sector Brokers to to ship cluster data to appropriate Sector Level 3 CPUs**
- **Level 3 systems churns the cluster data, makes a "decision" and informs Global Broker**
- **If the decision is "release" (discard) the Global Broker informs all subsystems (I.e. Sector Brokers) which in turn inform all Mezzanines which in turn release the particular event buffer and release the BUSY thus making it available for a next event**
- **If the decision is "accept" the GB passes control onto the Event Builder which synchronizes the Sectors and tells them to start shipping data to EVB's buffers**
- **Once the event is completely built the event is passed onto the Bufferbox (BB) which caches the event, and sends it to RCF for final storage**
- **When the event reaches BB, EVB "releases" the event locally in DAQ thus freeing corresponding frontend buffers, releasing BUSY etc.**

Theory of operation II

(RICH, TOFp, PMD, EMC i.e. those having no Receiver Boards)

- RICH handles the event at a lower level, on the platform, outside the scope of DAQ proper
- This level handles the buffering, processing and BUSY handling – DAQ has no control of RICH's BUSY – it can't even determine it
- Once the event is accepted by the RICH it is passed to DAQ's RICH Broker (RIC01) which only handles the necessary communication and organizes the data path to the EVB



DAQ Components

Core DAQ Systems
Event Builder
- **Bufferbox**

Global Broker/Token Manager
- **Trigger-DAQ Interface (TDI)**
- **Global Level 3 systems**

Detectors
Sector Level 3 systems (considered "detectors")
TPC (similar hierarchy for SVT, SSD & FTPC)
- **12 "sector" crates**
  - **➔ 12 Receiver Boards**
    - **➔ 3 Mezzanine CPUs**

SVT
- **2 "sector" crates**

SSD
- **1 "sector" crate**

FTPC
- **2 "sector" crates**

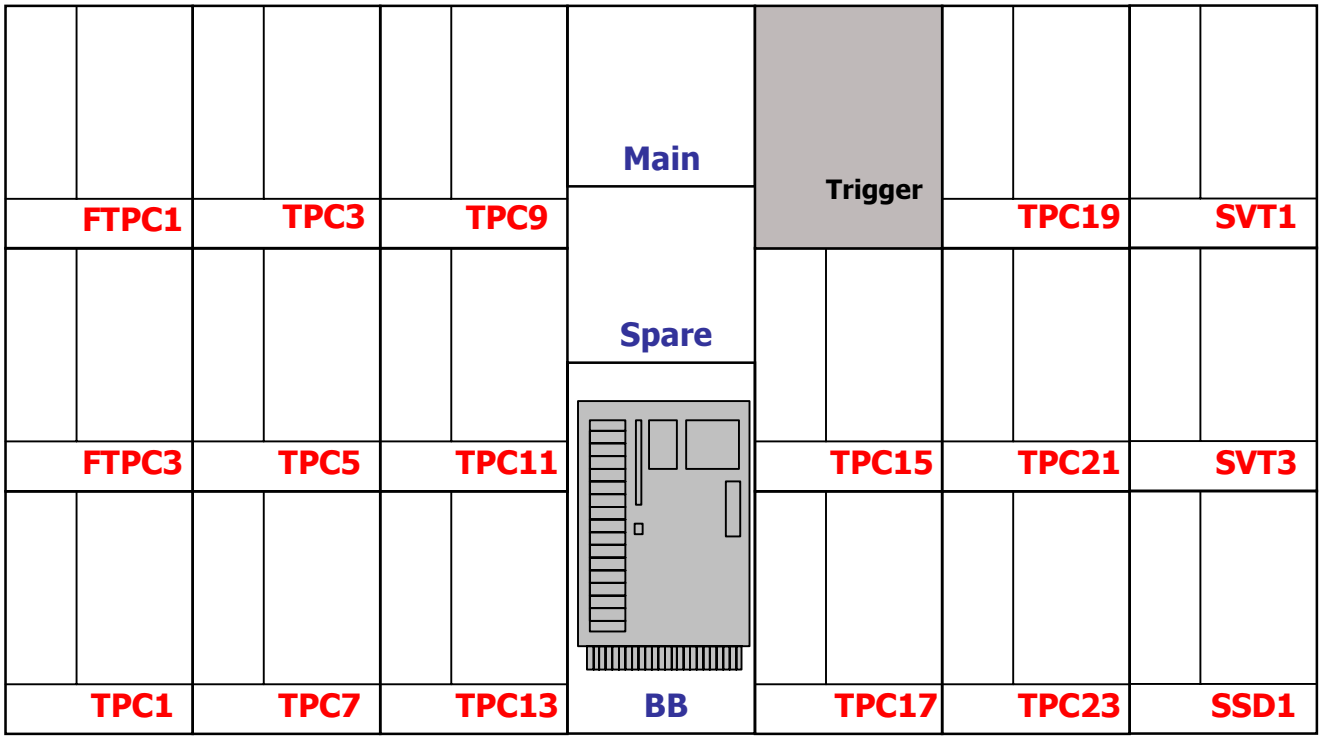
RICH
- **1 Broker CPU**

DAQ Components II

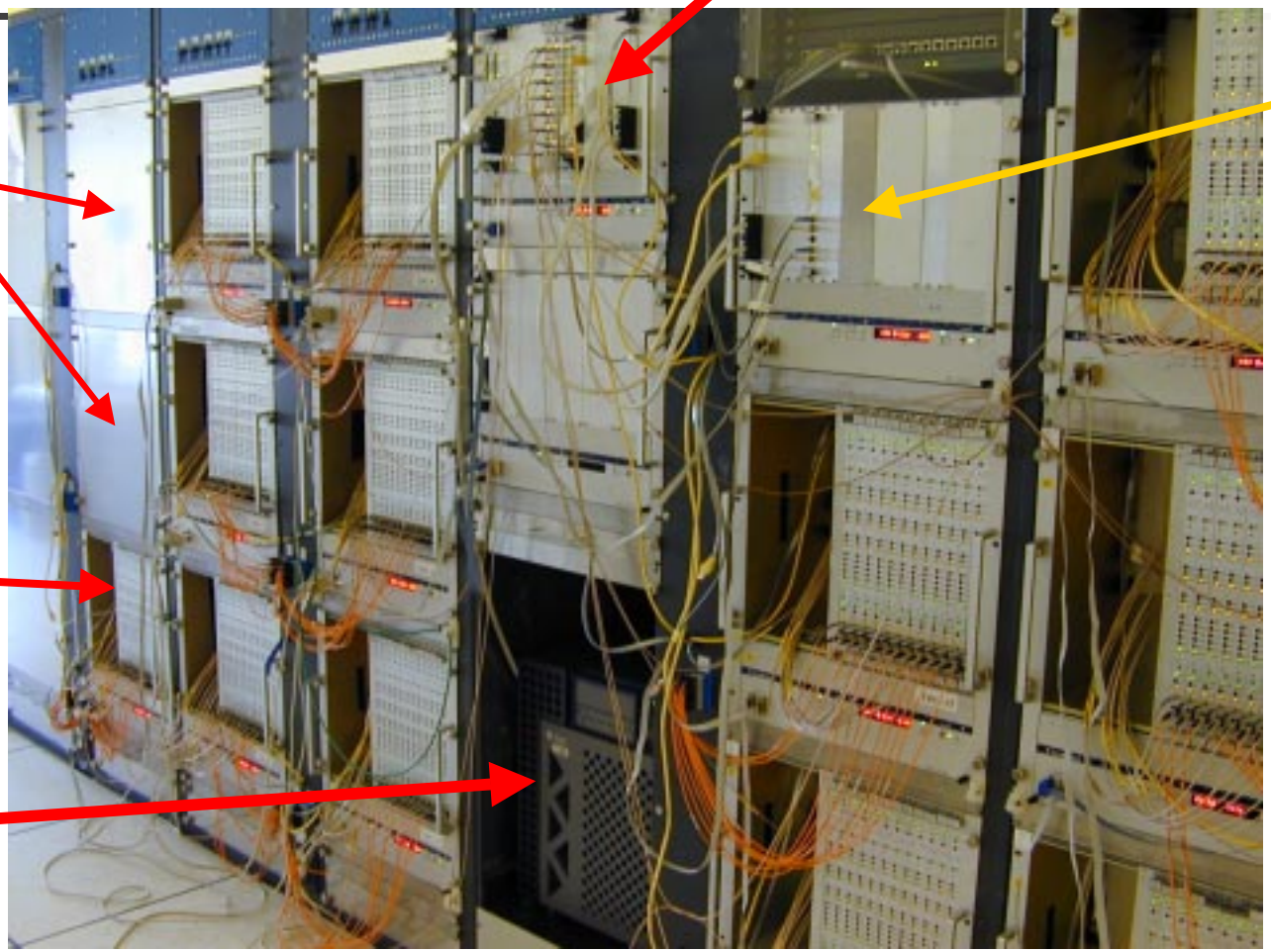
(Core Systems – Main Crate)

- Event Builder (EVB)
  - Handles synchronization and data movement once the event is accepted for storage
  - Handles the Event Pool communication
- Bufferbox (BB)
  - Sun Solaris machine which acts as a gateway/cache between DAQ and RCF
  - Also has 2 Sony DTF tapes in case of RCF downtime (42 GB tapes @ 12 MB/s data rate)
- Global Broker/Token Manager (GB)
  - Manages the event as it passes to DAQ from Trigger
  - Acts as the gateway between Trigger (and Trigger Detector Information) and the rest of DAQ as well as Level 3

Crate Layout in the DAQ room

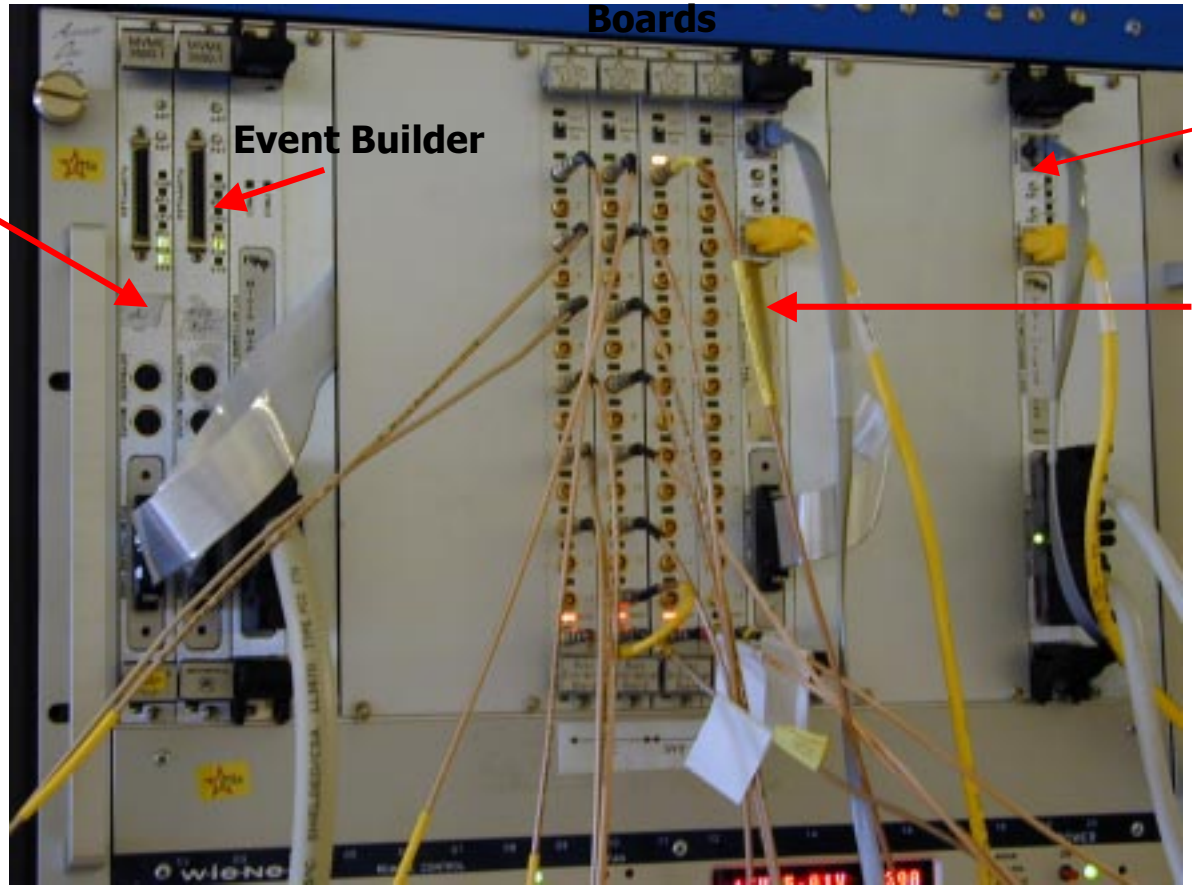


DAQ Racks I



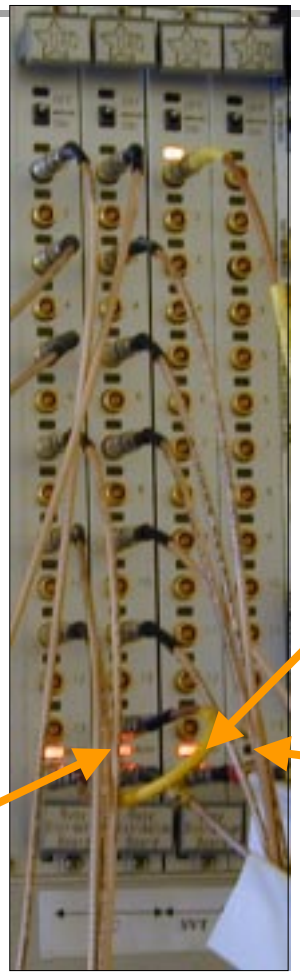
DAQ Racks II
(just a different perspective…)
((I love that digital camera, ☺))

Main Crate

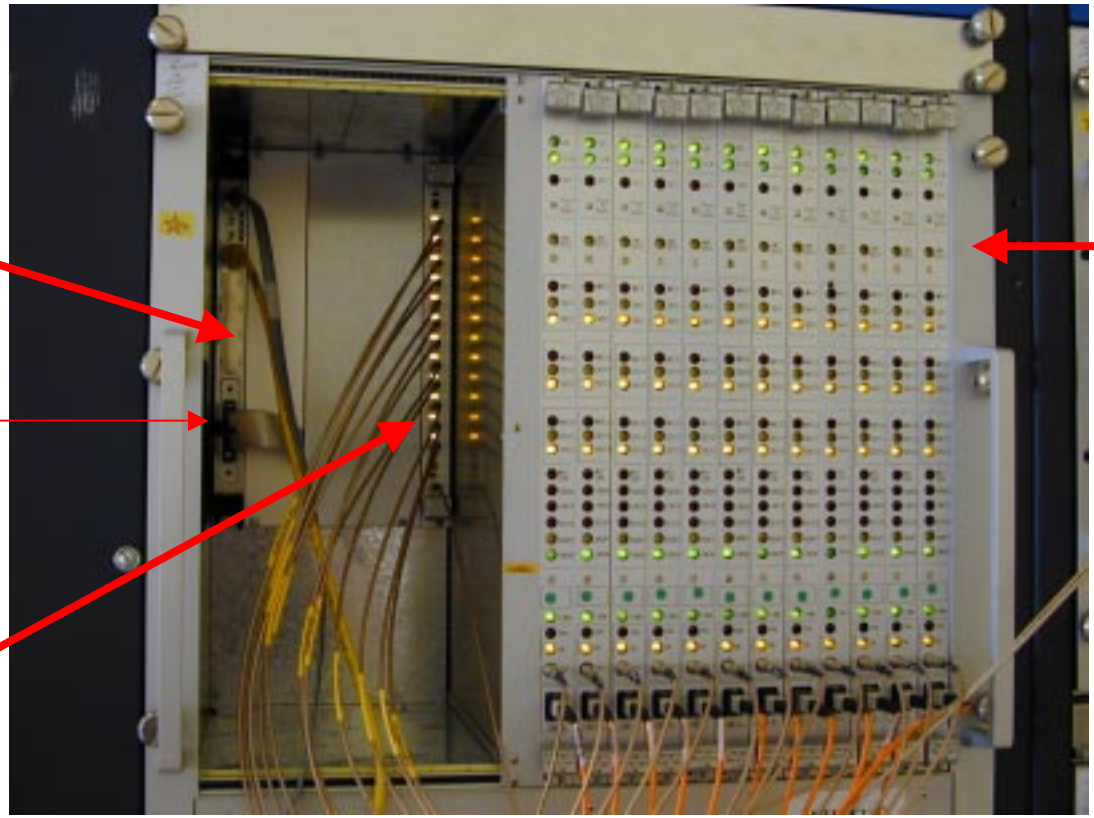

BUSY Distribution Boards
Global Broker
Event Builder
Trigger Interface (TDI)
RICH Broker (RIC01)

DAQ BUSY Outputs

AMBER
Lights at the Bottom
Mean
LIVE



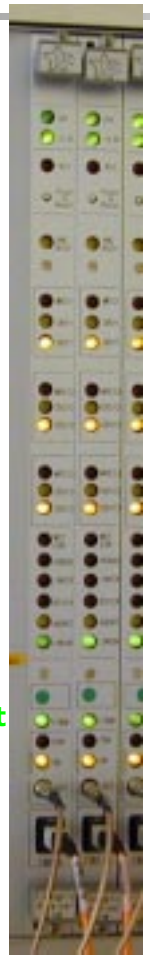
A DAQ Crate
(9U VME)



TPC, SVT, SSD & FTPC Receiver Board

Under Normal Operation

- **All green lights ON!**
- **NO Red Lights EVER!**
- **BUSY On, Event BUSY & VME Master flicker…**



LEDs:
Green – Status
Yellow – Informational
Red – ERROR!

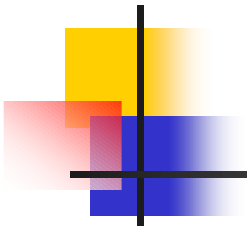
Power 5 & 3.3 V
Reset Active
Reset Button
VME Master
Mezzanine 1
Mezzanine 2
CPU in Reset
Mezzanine 3
Event BUSY
Software BUSY
Wdog Error
Bad Link Header
Link Error
BUSY Overrun
Abort
Optical Link Sync'ed
Fiber Light Present
BUSY Disabled!
BUSY On
BUSY Output LEMO
Fiber Input

Configuration I
Detector/System selection

- One can “add”/”subtract” Systems and their subparts via Run Control
  - TPC, SVT, FTPC, SSD
    - Sectors
      - Receiver Boards
  - RICH
  - Global Level 3
    - Participating CPUs
  - Sector Level 3
    - Participating CPUs
  - TDI should generally be ENABLED

Configuration II
Running…

- When starting a run one may choose
  - The Run Type
    - Pedestal
    - Physics
    - Configuration
    - All others are for experts ONLY
  - Destination
    - RCF Only
    - All others are for experts ONLY



DAQ Run Type I

- Defines the intended behavior of the DAQ System as a whole
- Defines the processing algorithms used inside DAQ as well as Level 3
- Defines the Data Format on output
- Defines the processing at the end of run i.e. for a Pedestal run DAQ calculates means & sigmas
- Each Run Type has an additional set of 3 per-detector parameters
  - Pedestals ON/OFF
  - Gain Curve (Linear/See-saw/Logarithmic/Gain Corrected/Other)
  - Analysis None/Cluster Finding/Other
- After reboot or after any detector/subdetector additions one MUST first take a Pedestal Run!!!! REMEMBER!

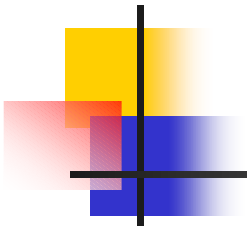
DAQ Run Type II
Current Defaults

- Pedestal Run
  - For each event keep the running mean and sigma
  - Data format on output is RAW
  - Upon end of run calculate means & sigmas

	Pedestals	Gain	Analysis
All Systems	NO	Linear	None

- Configuration Run ("Geometry" – makes sense for the TPC only)
  - Do nothing while running
  - Data format on output is RAW
  - At end of run do nothing

	Pedestals	Gain	Analysis
All Systems	NO	See-saw	None



DAQ Run Type III

- Physics Run
  - TPC
    - Run cluster finder
    - Pedestal subtraction ON
    - Gain correction : corrected logarithmic
    - Zero-suppress data
  - SVT
    - Do nothing
    - NO pedestal subtraction
    - Gain correction particular to SVT
    - Data format RAW
  - RICH
    - Do nothing,
    - Pedestal subtraction ON
    - Gain correction meaningless
    - Zero-suppress data
  - Level 3
    - Run track-finder

DAQ Monitoring I

```
Local Date :   Mon Jun  5 12:12:14 2000
q - quit
any - refresh                Samples 1207957, keypresses 15
```

Main	TDI	TM	GB	EVB01	BB Reader	BB Reader	BB Writer	BB Writer
Tkn Acc	10	N.A.	N.A.	N.A.	Tkn Acc	0	Tkn Acc	0
Tkn Rls	10	N.A.	N.A.	N.A.	Tkn Rls	0	Tkn Rls	0
Tkn Bad	10	N.A.	N.A.	N.A.	Tkn Bad	0	Tkn Bad	0
Evts In	1	0	0	0	Evts In	0	Evts In	0
Evts Run	30	0	0	0	Evts Run	0	Evts Run	0
Evts All	30	0	0	0	Evts All	0	Evts All	0
Evts Bad	18	0	0	0	Evts Bad	0	Evts Bad	0
Busy%	0	0	100	0	Busy%	0	Busy%	0
Evts/sec	0	0	0	0	Evts/sec	0	Evts/sec	0
EVB kB/sec	0	N.A.	0	0	EVB kB/sec	0	EVB kB/sec	0
Aux kB/sec	N.A.	N.A.	N.A.	0	Aux kB/sec	N.A.	Aux kB/sec	N.A.
State	PRESENT	PRESENT	PRESENT	PRESENT	State	PRESENT	State	PRESENT
Node Id	0x00A0	0x0060	0x0060	0x0080	Node Id	0x0040	Node Id	0x0040
Task Id	16	70	60	20	Task Id	181	Task Id	183
					Run Number:	0000000	local disk:	none
							RCF dir:	none

TPC	1	3	5	7	9	11	13	15	17	19	21	23
Tkn Acc	0	0	0	0	0	0	0	0	0	0	0	0
Tkn Rls	0	0	0	0	0	0	0	0	0	0	0	0
Tkn Bad	0	0	0	0	0	0	0	0	0	0	0	0
Evts In	0	0	0	0	0	0	0	0	0	0	0	0
Evts Run	0	0	0	0	0	0	0	0	0	0	0	0
Evts All	0	0	0	0	0	0	0	0	0	0	0	0
Evts Bad	0	0	0	0	0	0	0	0	0	0	0	0
Busy%	100	100	100	100	100	100	100	100	100	100	100	100
Evts/sec	0	0	0	0	0	0	0	0	0	0	0	0
EVB kB/sec	0	0	0	0	0	0	0	0	0	0	0	0
Aux kB/sec	0	0	0	0	0	0	0	0	0	0	0	0
State	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT
Node Id	0x1000	0x1040	0x1080	0x10C0	0x1100	0x1140	0x1180	0x11C0	0x1200	0x1240	0x1280	0x12C0
Task Id	1	1	1	1	1	1	1	1	1	1	1	1
RB val:cfg	00:12	00:12	00:12	00:12	00:12	00:12	00:12	00:12	00:12	00:12	00:12	00:12
buff EVB:L3	000:000	000:000	000:000	000:000	000:000	000:000	000:000	000:000	000:000	000:000	000:000	000:000

SVT	RICH	1	FTPC	1
Tkn Acc	Tkn Acc	0	Tkn Acc	0
Tkn Rls	Tkn Rls	0	Tkn Rls	0
Tkn Bad	Tkn Bad	0	Tkn Bad	N.A.
Evts In	Evts In	0	Evts In	0
Evts Run	Evts Run	0	Evts Run	11
Evts All	Evts All	0	Evts All	22
Evts Bad	Evts Bad	0	Evts Bad	0
Busy%	Busy%	0	Busy%	100
Evts/sec	Evts/sec	0	Evts/sec	0
EVB kB/sec	EVB kB/sec	0	EVB kB/sec	0
Aux kB/sec	Aux kB/sec	0	Aux kB/sec	0
State	State	PRESENT	State	READY
Node Id	Node Id	0x8000	Node Id	0x6000
Task Id	Task Id	1	Task Id	1
	RB val:cfg	00:00	RB val:cfg	01:01

DAQ Monitoring II

Main	TDI	TM	GB	EVB01
Tkn Acc	10	N.A.	N.A.	N.A.
Tkn Rls	10	N.A.	N.A.	N.A.
Tkn Bad	10	N.A.	N.A.	N.A.
Evts In	1	0	0	0
Evts Run	30	0	0	0
Evts All	30	0	0	0
Evts Bad	18	0	0	0
Busy%	0	0	100	0
Evts/sec	0	0	0	0
EVB kB/sec	0	N.A.	0	0
Aux kB/sec	N.A.	N.A.	N.A.	0
State	PRESENT	PRESENT	PRESENT	PRESENT
Node Id	0x00A0	0x0060	0x0060	0x0080
Task Id	16	70	60	20

States:

- **READY, PRESENT: can be reconfigured; run is stopped**
- **RUNNING: obvious; can't be reconfigured!**

What to do when it doesn't work!

1. CHECK that your Run Parameters make sense!!!
    1. Did you enable at least one detector?
    2. Did you enable Level 3 but L3 guys are out for lunch?
    3. Did you start a Physics run after a component rebooted/changed without performing a Pedestal run first?
2. Reboot via Run Control…
3. Reset the crate(s) via Slow Controls – pulse VME *SYSRESET
4. Call the expert

Problems I
general

- Most problems will be solved by rebooting via Run Control and repeating Pedestals etc.
  - Takes 30-50 seconds…
- If a system goes into "reverse video" on the DAQ monitoring screen – catastrophe – run is over…
  - *SYSRESET that crate from Slow Controls and restart the system via a RC Reboot
- DO NOT POWER-CYCLE CRATES!

Problems II

Run Start – takes 5-50 seconds…

- RC times out…
  - Reboot via RC
- RC times out again…
  - Find the system which is not in RUNNING and *SYSRESET via SC
- RC times out again…
  - If all the systems are in RUNNING – check to see if Level 3 is enabled but dead…
  - Call the expert…
- Some crate(s) have red lights on all mezzanines
  - *SYSRESET via SC, Reboot via RC, repeat Run Start
  - Check your enabled Sectors – did you add that crate?
- Some crates have some red lights on all 3 Mezzanines
  - Reboot via RC…
  - Check your Receiver Board mask for that crate – is that Receiver Board enabled?
  - Note the Sector/Receiver Board combo and keep running…

Problems III
during Run Stop

- RC Times out at Run Stop
  - Don’t worry – most of the data is already stored
  - If a system is “black”, *SYSRESET it via SC and reboot via RC
  - Restart Pedestals…

Problems IV
during running

- Generally - reboot via RC
- If a systems goes "black" *SYSRESET it via SC and then reboot via RC
- If a Receiver Board goes all RED
  - If only 1 so far – keep going…
  - If 2 or more so far – better stop the run, reboot and redo Pedestals…
- If event counters stop for a longer period of time (a minute…)
  - Check DAQ BUSY
    - If not BUSY – blame:
      1. RHIC
      2. The creation of a black hole…
      3. the Trigger Group
      4. …in that order – Trigger guys are my friends…
    - If BUSY – reboot DAQ, etc.etc.

Problems V

Dos and don'ts

- DO: log what happened
  - Date/time
  - When: run start, running, run stop
  - Your best estimate why it happened
  - What did you do…
  - If you just write "DAQ had problems" it will be disregarded by the DAQ group and blamed on you or Trigger (although they are my buddies…)
- DON'T:
  - Power-cycle crates (rather use *SYSRESET from Slow Controls)
- DON'T
  - Remove, replace, touch, be near, breath around or even think about the Crates and Receiver Boards

Who is STAR DAQ?

(Summer 2000 Lineup)

- Tonko Ljubicic
  - tonko@bnl.gov, x7346, cell 516-220-7981
- Jeff Landgraf
  - jml@bnl.gov, x7967, cell 516-220-7984
- John Nelson (will be at BNL only occasionally)
  - jmnelson@bnl.gov, x4575, cell TBD
- Clemens Alder (shared with Level 3, ☺)
  - cadler@bnl.gov, x8335, cell 516-220-7986
- Danny Padrazo (engineer)
  - padrazo@bnl.gov, x7838

DAQ Support

- We are on call only
- The name of the DAQ expert "on call" will be posted on the left side of the DAQ room window
- Typically same name for 24 hours (this may change depending on circumstances)
- If the listed expert doesn't answer your call – keep trying for at least 30 minutes!!!
- DO NOT CALL DAQ EXPERTS ROUND ROBIN IF THEY DON'T ANSWER IMMEDIATELY. (especially in the night)